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El Niño: The Years That Shook the World

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El Niño is the warm phase of the El Niño–Southern Oscillation (ENSO), a coupled ocean–atmosphere pattern that alters rainfall, temperature and circulation across the tropics and beyond. Major events in 1982–83, 1997–98 and 2015–16 demonstrated how Pacific Ocean variability can contribute to drought, flooding, wildfire risk, fisheries disruption and agricultural stress in distant regions. This article reviews these events and considers their relevance to India, where ENSO can influence but does not determine the southwest monsoon. It argues that the greatest societal losses arise when climate hazards meet exposure and limited capacity to respond. Improved forecasts, accessible early warnings, climate-resilient agriculture and careful water management can reduce harm, even though El Niño itself cannot be prevented (Timmermann *et al*., 2018; McPhaden, 1999; Kumar *et al*., 1999; Cai *et al*., 2014).

Keywords: El Niño; ENSO; climate variability; extreme weather; Indian monsoon; ecosystem resilience.

Pacific Ocean Warming and Its Global Reach

El Niño is the warming phase of the El Niño-Southern Oscillation (ENSO). The El Niño-Southern Oscillation is a naturally occurring climate pattern found within the tropical Pacific Ocean and atmosphere. Trade winds usually drive warm surface waters toward the western Pacific. Nutrient-rich, cooler waters rise near the coast of South America. During an El Niño event, however, the trade winds grow weaker, allowing the warm waters to spread across the Pacific. This leads to shifts in cloud formation, pressure and rainfall across many parts of the world (Timmermann *et al*., 2018; McPhaden *et al*., 2006). El Niño cannot produce the same effects everywhere but can still cause effects in many parts of the world, such as drought and heat waves. Still, some major El Niño events have demonstrated just how far-reaching its effects can be (Timmermann *et al*., 2018; McPhaden *et al*., 2006).

1982-83: A wake-up call for climate scientists

One of the strongest El Niños on record occurred in 1982-83. Parts of Peru and Ecuador received heavy rainfall, which led to destructive flooding. Some areas, in contrast, experienced unusually dry conditions. The warmer coastal waters also affected marine ecosystems. Shifts in the nutrient-rich waters off the coast of Peru disrupted the food chain for marine animals such as fish and seabirds (Barber & Chavez, 1983; McPhaden *et al*., 2006). This event revealed how hard El Niño can be to monitor and predict. Even though scientists understood the general pattern of El Niño, it was difficult to tell when it would strike and how it would affect distant regions. This resulted in more funding being allocated to monitoring and forecasting the ocean (McPhaden *et al*., 2006).

1997-98: Worldwide Impacts

The 1997-98 El Niño event drew considerable attention worldwide. Certain parts of South America experienced severe rainfall and flooding. Yet regions of Indonesia endured drought, which sparked extreme wildfires in their forests and peatlands. This caused smoke and haze

to spread throughout Southeast Asia, worsening air quality (McPhaden, 1999; Page *et al*., 2002). Some regions experienced severe flooding while others faced extreme dryness. This event demonstrated how greatly climate risk can impact areas beyond a single country. It also demonstrated how valuable satellites, ocean monitoring and international cooperation can be for tracking this climatic pattern (McPhaden, 1999; McPhaden *et al*., 2006).

2015-16: El Niño in a warming world

This was another exceptionally strong El Niño event. Regions of southern Africa endured drought, putting pressure on their water and agriculture. Yet other areas of the world received damaging rainfall. During this period, global temperatures reached extremely high levels. Because of long-term global warming driven by human activity, this was a highly important event to study. El Niño and global warming are distinct phenomena. El Niño is a natural climatic pattern. Global warming, in contrast, is mainly caused by the accumulation of greenhouse gases from human activity. Nevertheless, a strong El Niño in a warmer world can lead to greater heat stress and added strain on people, animals and ecosystems (NOAA Climate.gov, 2016; Blunden & Arndt, 2016; Cai *et al*., 2014).

2023-24: The most recent strong event

The most recent major event began in June 2023 and was declared over by Australia's Bureau of Meteorology in April 2024 (TWC India, 2024b). According to the World Meteorological Organization, it developed rapidly in July–August 2023, reached moderate strength by September (Tribune India, 2023), and was at its strongest between November and January, ranking among the five strongest events on record (Outlook India, 2024). Between November 2023 and January 2024, sea surface temperatures in the tropical Pacific ran about 2 °C above normal, a threshold that had been crossed only six times in the historical record (TWC India, 2024a). This event unfolded against a background of long-term warming. The WMO noted that every month since June 2023 had set a new monthly temperature record and that 2023 was by far the warmest year on record (Outlook India, 2024). In India, the year brought a hot summer, the driest August in 120 years and a monsoon rainfall deficit of about 6 per cent, with rainfall unevenly distributed across the country (TWC India, 2024a). The episode is a reminder that a strong El Niño does not guarantee the same impact everywhere (Tribune India, 2023), but also that forecasts issued months ahead gave governments and communities time to prepare (Outlook India, 2024).

Implications for the Indian Monsoon

For India, El Niño is something scientists and policymakers closely watch because of how it connects to the Southwest Monsoon. El Niño can raise the chance of below-average rainfall during the monsoon, though that is not always what happens. The monsoon is also shaped by numerous other weather and ocean factors. Not all El Niño years lead to low rainfall (Kumar *et al*., 1999; Tribune India, 2023). Rainfall shortages can have major effects on sectors beyond agriculture. Farmers might need to postpone sowing their crops, or they may end up with smaller harvests. Water stored in reservoirs and underground supplies can come under greater strain. Rural households can become more exposed to hardship. Seasonal forecasts, saving water, planning crops carefully and receiving timely guidance can help communities handle these risks (McPhaden *et al*., 2006; TWC India, 2024a).

Conclusion

Lessons from past events such as 1982-83, 1997-98 and 2015-16 have shown how closely the ocean and atmosphere are tied to our food, public health, livelihoods and ecosystems. Satellites, ocean buoys and climate models have helped us forecast El Niño. Nevertheless, we need to make sure that people are ready for the risks (McPhaden *et al*., 2006; NOAA Climate.gov, 2016). Since the ocean has no borders, the effects of changing temperatures are not confined by borders either. El Niño serves as a reminder that our world is interconnected, which means we must share what we know, plan carefully, and be ready (McPhaden *et al*., 2006).

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